# Neonatal Pain Policy

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## Introduction

There have been several recent consensus statements concerning neonatal pain \(^1\) \(^2\) \(^3\) \(^4\) \(^5\). This policy draws extensively from these references, in particular the most recent two, evidence-based statements\(^1\) \(^2\). The same general outline has been used as in Anand et al 2001\(^2\) which summarises the literature up to 2001.

The literature review, using key words of pain and pain measurement was used to update the suggested management approaches for neonatal pain (evidence-based consensus statements) assisted greatly by Shah and Olsson\(^1\). The Cochrane Library was searched for systematic reviews and randomised controlled trials and then MEDLINE, CINAHL and EMBASE databases. The search strategy was limited to "infant newborn or newborn" and to human and English language and systematically explored guidelines, systematic reviews, randomised control trials, clinical trial, consensus statements, evidence based reviews from 2001 to 2004. Cross references were obtained from the bibliography of identified papers.

The International Association for the Study of Pain (IASP) has developed a standard definition of pain, noting that pain is always subjective: "An unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (www.lasp.org).
Neonates, both term and preterm, experience pain and have the right to receive effective and safe pain relief. Compared with the adult, the neonate at birth, whether term or preterm, displays a hypersensitivity to sensory stimuli. While self-report, usually by using a linear analog scale, is regarded as the most reliable estimate of pain and considered the gold standard, neonates cannot verbalise their pain and thus depend on others to recognise, assess and manage their pain.

Common misconceptions concerning newborn pain still exist and include first, the false premise that newborns do not have the neurological substrate for the perception of pain because of lack of myelination, incomplete pain pathways from the periphery to the cortex, or immaturity of the cerebral cortex; second, that newborns do not remember pain, or if they do, it has no adverse effects; third, that it is too dangerous to administer anesthesia or postoperative analgesia to newborn infants. The evidence to refute these misconceptions is contained in the consensus statements by Anand and the American Academy of Pediatrics.

The general principles for the prevention and management of pain in newborns

(Adapted from Table 1 Anand 2001 and Bell 1994 and supported by evidence listed in AAP 2000)

1. Neuroanatomical components and neuroendocrine systems are sufficiently developed to allow transmission of painful stimuli in the neonate.
2. Pain in newborns is often unrecognised and undertreated. Neonates do feel pain, and analgesia should be prescribed when indicated during medical care.
3. If a procedure is painful in adults it should be considered painful in newborns, even if they are preterm.
4. Compared with older age groups, newborns may experience a greater sensitivity to pain and are more susceptible to the long-term effects of painful stimulation.
5. Adequate treatment of pain may be associated with decreased clinical complications and decreased mortality.
6. The appropriate use of environmental, behavioral and pharmacological interventions can prevent, reduce or eliminate neonatal pain in many clinical situations.
7. Sedation does not provide pain relief and may mask the neonate's response to pain.
8. Health care professionals have the responsibility for assessment, prevention and management of pain in neonates. Severity of pain and effects of analgesia can be assessed in the neonate.
9. Clinical units providing health care to newborns should develop written guidelines for the management of neonatal pain.
10. A lack of behavioral responses (including crying and movement) does not necessarily indicate a lack of pain.
11. Systematic approach to pain management includes:
   - Prevention, limiting, avoiding noxious stimuli
   - Assessment of neonatal pain by standardised methods with demonstrable validity, reliability and clinical utility
   - Treatment including non-pharmacological (behavioural) and pharmacological

12. Environment should be as conducive as possible to the well being of the neonate and family:
   - Avoiding unnecessary noxious stimuli (acoustic, visual, tactile, vestibular)
   - Minimising painful or stressful procedures (placement peripheral, central, arterial lines to reduce repeated IV punctures)
   - Non-invasive measurement where possible eg oximeter (small baby guideline), bilirubinometer
   - Behavioural measures: sucrose, swaddling, non-nutritive sucking (pacifier/dummy), multisensory stimulation, skin to skin contact
   - Pharmacological therapy when indicated with appropriate safe dosage by using computer generated medication doses
Consequences of newborn pain

Newborn pain, which itself is generally a consequence of intervention, has both immediate, short term and long term consequences. The latter is an emerging field of research and particularly important as the possible impact of multiple, neonatal pain exposure in NICU on neurodevelopment, potentially contributes to later problems with attention, learning and behaviour.

- Newborn infants subjected to a variety of noxious stimuli have immediate hormonal, physiological and behavioural responses.

- Term and preterm infants behave differently in their short term response to pain. Prior pain experience in healthy, term babies appears to increase subsequent behavioural response to pain. By contrast, in preterm infants prior pain experience appears to diminish subsequent behavioural response to pain.

- Painful neonatal experiences do have long-term consequences and even if not expressed as conscious memory, memories of pain maybe recorded biologically and alter brain development and subsequent behaviour. This is consistent with laboratory studies in animal models where early injury can induce long-term behavioural and CNS effects which persist into adulthood. Taddio et al. reported that circumcised boys had higher pain and cry scores during routine immunisation at 4-6 months of age than uncircumcised boys and scores were again higher if circumcision was unaccompanied by analgesia compared with those receiving topical anaesthesia. Thus some of these effects can be modified by analgesia. In older children, lower pain sensitivity in ELBW toddlers at 18 months of age compared with controls and significantly higher scores for non specific physical complaints with no known medical cause at 4.5 years of age, have been reported by parents (summarised in Whitfield and Gruneau).

Painful Procedures Commonly Performed in the Neonatal Intensive Care Unit

(from Anand 2001)

<table>
<thead>
<tr>
<th>Diagnostic</th>
<th>Therapeutic</th>
<th>Surgical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial puncture</td>
<td>Bladder catheterization</td>
<td>Other surgical procedures</td>
</tr>
<tr>
<td>Bronchoscopy</td>
<td>Central line insertion/removal</td>
<td>e.g. peritoneal drain, cut-down</td>
</tr>
<tr>
<td>Endoscopy</td>
<td>Chest tube insertion/removal</td>
<td></td>
</tr>
<tr>
<td>Heel lancing</td>
<td>Chest physiotherapy</td>
<td></td>
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<tr>
<td>Lumbar puncture</td>
<td>Dressing change</td>
<td></td>
</tr>
<tr>
<td>Retinopathy of prematurity examination</td>
<td>Gavage tube insertion</td>
<td></td>
</tr>
<tr>
<td>Suprapubic bladder tap</td>
<td>Intramuscular injection</td>
<td></td>
</tr>
<tr>
<td>Venipuncture</td>
<td>Laser therapy for retinopathy</td>
<td></td>
</tr>
<tr>
<td>Eye examination</td>
<td>Peripheral venous catheterization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mechanical ventilation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Postural drainage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Removal of adhesive tape</td>
<td></td>
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<tr>
<td></td>
<td>Suture removal</td>
<td></td>
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<tr>
<td></td>
<td>Tracheal intubation/extubation</td>
<td></td>
</tr>
</tbody>
</table>
Why bother with newborn pain relief?

- Humane
- Repeated episodes of pain in NICU do occur
- Immature nervous system cannot modulate effectively
- Long term effects documented
- Pain habituation may alter the preterm brain
- Stressful for parents

Responses of infants to pain

(from Mathew and Mathew 2003)  

<table>
<thead>
<tr>
<th>Physiological changes</th>
<th>Behavioural changes</th>
<th>Hormonal changes</th>
<th>Autonomic changes</th>
<th>Body movements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increase in:</strong></td>
<td><strong>Change in facial expression:</strong></td>
<td><strong>Increased release of:</strong></td>
<td><strong>Changes:</strong></td>
<td><strong>Movements:</strong></td>
</tr>
<tr>
<td>Heart rate</td>
<td>Grimacing</td>
<td>Cortisol</td>
<td>Mydriasis</td>
<td>Finger clenching</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Screwing up of eyes</td>
<td>Catecholamines</td>
<td>Sweating</td>
<td>Thrashing of limbs</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Nasal flaring</td>
<td>Glucagon</td>
<td>Flushing</td>
<td>Writhing</td>
</tr>
<tr>
<td>Oxygen consumption</td>
<td>Deep nasolabial groove</td>
<td>Growth hormone</td>
<td>Pallor</td>
<td>Arching of back</td>
</tr>
<tr>
<td>Mean airway pressure</td>
<td>Curving of the tongue</td>
<td>Renin</td>
<td></td>
<td>Head hanging</td>
</tr>
<tr>
<td>Muscle tone</td>
<td>Quivering of the chin</td>
<td>Aldosterone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intracranial pressure</td>
<td></td>
<td>Antidiuretic hormone</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Reduced secretion of:
- Insulin

Assessment of pain in neonates

Assessment of pain in the neonate is complicated by the inability of neonates to verbalise pain. Thus while self reporting is the single most reliable indicator of the existence and intensity of acute pain, indirect measurements including hormonal, behavioural, physiological measures have been used to validate pain in the neonate. There are a variety of tools available for the assessment of neonatal pain which rely on contextual indicators (gestational age, sleep/wake state), behavioural responses, physiological responses or a combination of the three. Four assessment tools which have been variably evaluated are listed below. These are included because they are multi-dimensional and demonstrate evidence of reliability, validity and utility.

Commonly Used Methods for Assessment of Pain in
### Newborns

*(from Anand 2001)*

#### Variables assessed

<table>
<thead>
<tr>
<th>Premature Infant Pain Profile (PIPP)</th>
<th>Neonatal Facial Coding Scale (NFCS)</th>
<th>Neonatal Infant Pain Scale (NIPS)</th>
<th>CRIES Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational age</td>
<td>Brow bulge</td>
<td>Facial expression</td>
<td>Crying</td>
</tr>
<tr>
<td>Behavioral state</td>
<td>Eye squeeze</td>
<td>Cry</td>
<td>Requires</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>Nasolabial furrow</td>
<td>Breathing patterns</td>
<td>increase</td>
</tr>
<tr>
<td>Oxygen saturation</td>
<td>Open lips</td>
<td>Arms</td>
<td>Oxygen</td>
</tr>
<tr>
<td>Brow bulge</td>
<td>Stretch mouth</td>
<td>Legs</td>
<td>administration</td>
</tr>
<tr>
<td>Eye squeeze</td>
<td>Lip purse</td>
<td>State of arousal</td>
<td>Increased</td>
</tr>
<tr>
<td>Nasolabial furrow</td>
<td>Taut tongue</td>
<td></td>
<td>vital signs</td>
</tr>
<tr>
<td></td>
<td>Chin quiver</td>
<td></td>
<td>Expression</td>
</tr>
<tr>
<td></td>
<td>Tongue protrusion</td>
<td></td>
<td>Sleeplessness</td>
</tr>
</tbody>
</table>

#### Reliability data

- Interrater and intrarater Reliability > 0.93
- Interrater reliability > 0.92
- Interrater reliability > 0.72

#### Forms of validity established

- Face, content, construct (in preterm and term neonates)
- Face, content, construct, and convergent ($r = 0.89$)
- Face, construct, and concurrent ($r = 0.53-0.84$)
- Face, content, discrimination, and concurrent ($r = 0.49-0.73$)

#### Clinical utility

- Feasibility and utility established at bedside
- Feasibility established at bedside
- Not established
- Nurses preferred CRIES over another scale

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### Principles of Management of pain in neonates

#### Prevention

- Consider whether each test / intervention is necessary or can be reduced
- Use a non-invasive method where possible eg oximeter, bilirubinometer
- Use central lines (umbilical) rather than peripheral
- Consider central or peripheral long lines rather than repeated IV lines for longer term use
- Use arterial line rather than repeated arterial stabs

#### Environment

- Reduce stress from noxious stimuli (acoustic, visual, tactile, vestibular)

#### Behavioural methods

- Breast feeding, glucose/sucrose, non nutritive sucking, swaddling, multisensory stimulation

#### Pharmacological agents

- For preemptive analgesia

#### Pharmacological therapy

- For ongoing pain

### Suggested Management Approaches for Neonatal Pain
In 2004, there are high levels of evidence (systematic reviews and randomised control trials) to indicate which behavioural and pharmacological interventions are effective in reducing neonatal pain. The combined use of multiple interventions may have additive or synergistic clinical effects, for example multisensory stimulation and glucose are more effective than either alone in reducing pain due to heel lancing.

At RPA Newborn Care we use:

| First option analgesia for all procedures except when a body cavity is being entered | Sucrose and pacifier + multisensory stimulation OR Breast feeding + multisensory stimulation |
| Analgesia when a body cavity is being entered (ie chest or peritoneal drains + possibly LP) | Lignocaine infiltration + Consider opiate analgesic Consider EMLA cream if time and clinical situation permits |

Heel lancing

1. Venepuncture is the preferred method for blood sampling in term newborns as it is less painful, more efficient and requires less resampling. This approach may not apply to the care of extremely preterm infants.
   - Use a pacifier with sucrose (concentration 12% - 24%) given 2 minutes before the procedure as a pacifier enhances the analgesic effect of sweet solutions OR
     - Encourage the mother to breast feed or if the baby is taking artificial milk then bottle feed during the procedure.
   - Ensure the parent or carer holds the infant during the procedure and employs multisensory stimulation (+/- skin contact) OR
     - Use swaddling, containment by flexing and holding the infant and employ multisensory stimulation
   - Consider applying EMLA (0.5-1g) 60-90 minutes prior to venepuncture when non urgent and NICU organisational safety makes this option possible.

2. If heel lancing is used:
   - Do not warm the heel prior to lancing as this does not reduce pain or aid blood collection during lancing.
   - Use a pacifier with sucrose (concentration 12% - 24%) given 2 minutes before the procedure as a pacifier enhances the analgesic effect of sweet solutions OR
     - Encourage the mother to breast feed or if the baby is taking artificial milk then bottle feed during the procedure.
   - Ensure the parent or carer holds the infant during the procedure and employs multisensory stimulation ± skin contact OR
   - Use an automated lancet, preferably fully retractable.
NOTE: in a quasi randomised study it was found that if oral glucose 30% was given prior to heel lancing or venepuncture pain scores (PIPP score) were reduced to a similar low score.

NOTE: Topical anaesthesia, that is EMLA cream (a eutectic mixture of local anesthetics: lidocaine and prilocaine hydrochloride in an emulsion base) or amethocaine gel or 5% lignocaine ointment, acetaminophen, and warming the heel are ineffective for heel lancing; squeezing for blood collection is the most painful part of the procedure.

Intramuscular injections eg Vit K

- Use a pacifier with sucrose (concentration 12% - 24%) given 2 minutes before the procedure as a pacifier enhances the analgesic effect of sweet solutions.
- Use holding, swaddling or containment by flexing and holding the infant and employ multisensory stimulation (+ skin contact).
- Avoid subcutaneous and intramuscular injections; give drugs intravenously whenever possible.

NOTE: Application of EMLA cream (0.5-1g) 60-90 minutes prior to injection (for single injection) was not considered practical for Vit K injection as to ensure maximum compliance this is given shortly after birth at most hospitals.

Nasogastric or Orogastric Tube Insertion

- Use a pacifier with sucrose.
- Use holding, swaddling or containment by flexing and holding the infant.
- Use a gentle technique with appropriate lubrication ensuring the head is in the neutral or "sniffing" position and inserting the tube in a vertical direction at right angles to the face.

Umbilical Arterial & Venous Catheter Insertion

If a newborn seems distressed during the procedure employ the following:

- Consider the use of a pacifier with sucrose.
- Use containment by holding the infant.
- Avoid the placement of sutures or hemostat clamps on the skin around the umbilicus.

(Secure with tape immediately following insertion using the “goal post” method)

Periferal Arterial & Venous Punctures/Insertions

This includes Arterial Puncture, Percutaneous Venous Catheter Insertion, Percutaneous Arterial Catheter Insertion, Peripheral Arterial or Venous Cutdown, Peripheral Central Venous Catheter Insertion

- Use a pacifier with sucrose.
- Use swaddling or containment by holding the infant.
- Consider opioid dose(s), if intravenous access is available.
- Consider subcutaneous infiltration of lignocaine.
- Consider applying EMLA (0.5-1g) to the proposed site 60-90 minutes prior to insertion (when non-urgent and NICU organisational safety makes this option possible).

Lumbar Puncture
- Use a pacifier with sucrose\textsuperscript{16,17}
- Consider subcutaneous infiltration of lignocaine\textsuperscript{35,40}
- Consider applying EMLA (0.5-1g) the proposed site 60-90 minutes beforehand\textsuperscript{25,41}

## Endotracheal Intubation

- Use a combination of morphine, succinlycholine with or without atropine at RPA Newborn Care
- Tracheal intubation without the use of analgesia or sedation should be performed only for resuscitation in the delivery room or for other life-threatening situations associated with the unavailability of intravenous access\textsuperscript{42,43,44}

Other approaches that have been used in the literature as listed below. The superior efficacy of any one technique is not supported by current evidence\textsuperscript{35,40,42,43,44,45}

- Use combination of atropine sulfate and ketamine hydrochloride\textsuperscript{42}
- Use combination of atropine, thiopental sodium,* and succinylcholine chloride\textsuperscript{44}
- Use combination of atropine, morphine, or fentanyl, and nondepolarizing muscle relaxant (pancuronium, vercuronium, rocuronium)\textsuperscript{34,35}
- Consider using a topical lignocaine spray, if available\textsuperscript{45,46}
- Other drug combinations are frequently used\textsuperscript{35,40}

## Endotracheal Suction

This is considered a stressful procedure and may be associated with the same physiological responses that accompany other painful procedures\textsuperscript{43,47,48,49,50,51}

- Use a pacifier\textsuperscript{52}, may consider giving sucrose\textsuperscript{16,17}
- Use swaddling or containment, by holding the infant\textsuperscript{30,31}
- Consider continuous intravenous infusion of opioids (morphine)\textsuperscript{47} or slow injection of intermittent opioid doses (morphine), although this may not be indicated in preterm infants\textsuperscript{53}

## Chest Tube Insertion

- Anticipate the need for intubation and ventilation in neonates breathing spontaneously\textsuperscript{35}
- Use a pacifier with sucrose\textsuperscript{16,17}
- Use subcutaneous infiltration of lignocaine\textsuperscript{35,40}
- Consider slow intravenous opioid infusion (morphine)\textsuperscript{34,35}

Intravenous midazolam is not recommended\textsuperscript{54,55}

## Laser Therapy for Retinopathy of Prematurity

- Intubate and ventilate in neonates breathing spontaneously.
- Use a pacifier with sucrose\textsuperscript{16,17}
- Consider slow intravenous opioid infusion (morphine)\textsuperscript{34,35}
- Intravenous midazolam is not recommended\textsuperscript{54,55}
- Other approaches may include the use of short acting anesthetic agents\textsuperscript{34,35}
- Consider oral paracetamol after extubation and use of a pain score.
**Circumcision:**

The Paediatrics & Child Health Division, the Royal Australasian College of Physicians (RACP), after extensive review of the literature reaffirms that there is no medical indication for routine male circumcision. Refer to the circumcision policy at [http://www.racp.edu.au/hpu/paed/circumcision/index.htm](http://www.racp.edu.au/hpu/paed/circumcision/index.htm) where there is advice on analgesia and also a parent information brochure and to a more recent summary of interventions to minimise pain of circumcision.

In Australia, if circumcision is deemed necessary, most circumcisions are undertaken in boys older than six months under a general anaesthetic, with local anaesthetic often being administered during the general anaesthetic.

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**Ongoing Analgesia for Routine NICU Care and Procedures**

- Reduce acoustic, thermal, and other environmental stresses\(^{45, 56, 57}\)
- Use swaddling or containment, by holding the infant ± multisensory stimulation\(^{30, 31}\)
- Use a pacifier and if possible and safe to do so give with sucrose\(^{16, 17}\) (do not use routine, repeated doses of sucrose in infants < 31 weeks gestation)
- Consider low-dose continuous infusion of morphine if patient is ventilated\(^{47, 58, 59}\) although this may not be indicated in preterm infants\(^{53}\) (the use of midazolam is not recommended)\(^{54}\)

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**Key Points**

<table>
<thead>
<tr>
<th>Interventions with Evidence of Benefit</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venipuncture is less painful than heel lancing for blood sampling in newborns</td>
<td>★★★★ 15</td>
</tr>
<tr>
<td>Sucrose is safe and effective in reducing pain from heel lancing</td>
<td>★★★★ 16</td>
</tr>
<tr>
<td>Sucrose is safe and effective in reducing pain from venepuncture and heel lancing in preterm infants</td>
<td>★★★★ 60, 61, 62</td>
</tr>
<tr>
<td>Pacifiers (dummies), non nutritive sucking, rocking are effective in reducing pain responses</td>
<td>★★★★ 52, 63, 64</td>
</tr>
<tr>
<td>Sucrose with pacifiers are effective in reducing pain responses in newborn infants</td>
<td>★★★★ 17, 65, 66, 67</td>
</tr>
<tr>
<td>Sucrose and holding are effective in reducing pain responses</td>
<td>★★★★ 21</td>
</tr>
<tr>
<td>Multisensory stimulation (massage, voice, eye contact and perfume smelling) with oral glucose and sucking is most effective in reducing pain responses to heel lancing in term and preterm infants</td>
<td>★★★★ 14, 22</td>
</tr>
<tr>
<td>Breast feeding is effective in reducing pain responses during heel lancing in healthy newborns</td>
<td>★★★★ 18, 19</td>
</tr>
<tr>
<td>Intervention</td>
<td>Evidence Strength</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Skin to skin contact is effective in reducing pain responses during heel</td>
<td>★★★★☆ 23</td>
</tr>
<tr>
<td>lancing in newborns</td>
<td></td>
</tr>
<tr>
<td>Automated lancets are superior to conventional lancets (less need for repeat</td>
<td>★★★☆☆ 26, 27</td>
</tr>
<tr>
<td>punctures, shorter procedure time, increased volume of blood collected,</td>
<td></td>
</tr>
<tr>
<td>reduction in haemolysed blood samples)</td>
<td></td>
</tr>
<tr>
<td>A fully retractable automatic lancet is superior to a partially retractable</td>
<td>★★★★☆ 28, 66, 69,</td>
</tr>
<tr>
<td>automatic lancet (less pain, less time to perform, fewer punctures but more</td>
<td>70</td>
</tr>
<tr>
<td>expensive)</td>
<td></td>
</tr>
<tr>
<td><strong>Interventions with No Evidence of Benefit or Evidence of Harm</strong></td>
<td></td>
</tr>
<tr>
<td>EMLA cream, topical amethocaine, lignocaine ointment, oral paracetamol</td>
<td>★★★☆☆ 25, 71, 72,</td>
</tr>
<tr>
<td>are not effective for heel lancing pain</td>
<td>73</td>
</tr>
<tr>
<td>Warming the heel does not reduce pain or aid blood collection during heel</td>
<td>★★★☆☆ 26, 27</td>
</tr>
<tr>
<td>lancing</td>
<td></td>
</tr>
<tr>
<td>Midazolam maybe associated with a higher incidence of adverse neurological</td>
<td>★★★☆☆ 54</td>
</tr>
<tr>
<td>events and longer NICU stay</td>
<td></td>
</tr>
<tr>
<td>Routine repeated use of sucrose analgesia in preterm neonates &lt;31 weeks</td>
<td>★★★☆☆ 74</td>
</tr>
<tr>
<td>post-conceptional age in the first week of life may result in poorer</td>
<td></td>
</tr>
<tr>
<td>neurobehavioural development and physical outcomes</td>
<td></td>
</tr>
<tr>
<td>Routine morphine infusion in preterm ventilated newborns has no measurable</td>
<td>★★★☆☆ 53</td>
</tr>
<tr>
<td>analgesic effect and no effect on poor neurological outcome</td>
<td></td>
</tr>
</tbody>
</table>

**References**

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